Section II (Remarks)

In the January 10, 2006 Office Action, claims 1-41 were rejected under various reference grounds, including:

- A rejection of claims 1, 10, 11, 14-16, 22-28, 35, and 36 under 35 USC § 102(b) over U.S. Patent 6,407,409 to Cho et al. ("Cho"); and
- A rejection of claims 2-12, 17-21, 31-34, and 37-38 under 35 USC § 103(a) over Cho in view of Heitz, et al. "Excited States of Fe3+ in GaN," Physical Review B, vol. 55, no. 7, February 15, 1997, pp. 4382-4387 ("Heitz").

Such rejections are traversed for the reasons stated below.

A. Rejections Under 35 USC § 102(b)

1. Law Regarding Anticipation

In order for a §102(b) rejection of claims to be legally proper, the single cited reference must meet the criteria stated in MPEP §706.02, i.e., the cited reference:

> **"must teach every aspect of the claimed invention either explicitly or implicitly. Any feature not directly taught must be inherently present."** (MPEP §706.02, Rejection on Prior Art [R-1]).

The governing law of CAFC decisions is consistent with such MPEP standard:

> "Anticipation requires the disclosure in a single prior art reference of each element of the claim under consideration." *W.L. Gore & Assocs. v. Garlock*, 721, F.2d 1540, 220 USPQ 303 at 313 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984). It is not enough that the prior art reference disclose all the claimed elements in isolation. Rather, "anticipation requires the presence in a single prior art reference disclosure of each and every element of the claimed invention, arranged as in the claim." *Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co.*, 730 F.2d 1452, 221 USPQ 481, 485 (Fed. Cir. 1984) (emphasis added). Further, "[u]nder 35 U.S.C. § 102, anticipation requires that ... the prior art reference must be enabling, thus placing the allegedly disclosed matter in the possession of the public." *Akzo, N.V. v. United States Int'l Trade Comm'n*, 808 F.2d 1471, 1 USPQ2d 1241, 1245 (Fed. Cir. 1986).

2. Patentability of Claims 1, 10, 11, 14-16, 22-28, 35, and 36 Over Cho

Claim 1 recites:

Large-area, single-crystal semi-insulating gallium nitride.

Cho refers to the fabrication of single crystal GaN having dimensions of approximately 2 inches in diameter, but fails to in any way disclose or suggest "**semi-insulating** gallium nitride" as required by claim 1.

Semi-insulators are characterized by bulk resistivity between 10^3 to 10^{10} ohm centimeters, but material of such character is not disclosed or suggested by Cho.

Cho contains no mention of "semi-insulative," "semi-insulating," "bulk resistivity (or "resistivity" at all, for that matter) "ohm centimeter" or any similar terminology that would in any way indicate a material of the type claimed by applicants.

Cho describes the formation of a GaN semiconductor with "uniform **n-type doping**" that is applied directly to the GaN substrate. Cho, col. 6, lines 60-65. The purpose of n-type doping is to produce an abundance of mobile or "carrier" electrons in the material, in which the concentration of electrons is much higher than the concentration of holes. Furthermore, Cho further teaches that such doping may be "**applied to one or both sides** of the GaN substrate ... [to provide] the advantage of allowing the production of semiconductor devices, LEDs, or optoelectronic devices with **doping on both sides** of the device." Cho, col. 6, line 67 – col. 7, line 4.

The n-type doping of GaN disclosed by Cho is well-known in the art and does NOT yield "semi-insulating" GaN material as recited in claim 1. With regard to doping and its effect, the present invention contemplates exactly the **opposite** as Cho – i.e., Cho contemplates the use of shallow n-type dopants that necessarily render the material n-type conductive, whereas the present invention contemplates doping with deep acceptor species to compensate such donor species. See, for example, paragraphs [0039]-[0040] of the instant application (as reproduced in pertinent part below), describing the conventional result of n-type conductivity GaN as compared to the intentional doping of deep acceptor species to compensate the donor species:

> [0039] The donor species in the grown gallium nitride may derive from defects in the material that are ionized to produce ionized centers and free conductive band electrons. **GaN growth processes invariably produce native defects and incorporate unintentionally doped impurities in the grown GaN material, producing an n-type conductivity GaN product.** The unintentionally doped impurities can for example include residual donor ions deriving from impurities in the reaction chamber in which the GaN is grown, e.g., as present in the walls of a quartz growth chamber. **These impurities function to lower the resistivity of the GaN material produced in the growth process.**
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>
> [0040] In accordance with the present invention, **large-area, semi-insulating GaN material is produced by intentional doping of deep acceptor species** in the gallium nitride material during growth thereof, **to compensate the donor species** deriving from defects and residual incorporated impurities of the grown material.

Thus, the examiner's blanket statement that "Cho teaches a large-area, single crystal semi-insulating gallium nitride" (January 10, 2006 Office Action, paragraph 4) is not supported by Cho's disclosure, since **Cho fails to teach or fairly suggest any "semi-insulating gallium nitride."**

Since Cho fails to disclose "each and every element of [claim 1], arranged as in the claim." (*Lindemann, supra),* claim 1 cannot be anticipated. Accordingly, withdrawal of the 102(b) rejection of claim 1 is warranted, and respectfully requested.

Claims 10, 11, 14-16, 22-28, 35, and 36 depend, whether directly or indirectly, from claim 1. Since dependent claims inherently include all the limitations of the claim incorporated by

reference into the dependent claim (37 CFR 1.75(c)), dependent claims 10, 11, 14-16, 22-28, 35, and 36 are similarly not anticipated by Cho. Accordingly, withdrawal of the 102(b) rejections of all of claims is respectfully requested.

B. Rejections Under 35 USC § 103

1. Rejections Under § 103 Generally

Three requirements must be met for a *prima facie* case of obviousness. First the prior art reference(s) must teach all of the limitations of the claims. M.P.E.P. § 2143.03. Second, there must be a motivation to modify the reference or combine the teachings to produce the claimed invention. M.P.E.P. § 2143.01. Third, a reasonable expectation of success is required. M.P.E.P. § 2143.02. In addition, the teaching or suggestion to combine and the expectation of success must both be found in the prior art and not based on Applicant's disclosure. M.P.E.P. § 2143.

2. Patentability of Claims 2-12, 17-21, 31-34, and 37-38

As indicated previously, claims 2-12, 17-21, 31-34, and 37-38 were under 35 USC § 103(a) over Cho in view of Heitz. Each of these claims 2-12, 17-21, 31-34, and 37-38 depends, whether directly or indirectly, from independent claim 1.

As demonstrated hereinabove, Cho fails to teach "semi-insulating gallium nitride." **Heitz fails to supply the teaching missing in Cho in this regard.** Indeed, the **examiner has already implicitly acknowledged as much, in withdrawing the prior 102(b) rejection premised on Heitz** made in the Office Action dated May 9, 2005.

For the convenience of the examiner, the distinctions between Heitz and the subject matter of claim 1 relating to the "semi-insulating" limitation are restated below.

There is no disclosure of bulk resistivity of the GaN material in Heitz. Instead, Heitz is focused on photoluminescence excitation results for iron (3+) luminescence in hexagonal GaN, but even here, Heitz refers to crystal material as having semi-insulating character on the basis of an electron paramagnetic resonance (EPR) signal that is observable in the dark (*see* Heitz at the page 4382,

second column, last paragraph ("[T]he Fe^{3+} EPR signal can be observed in the dark for the crystals 2 and 3 *confirming the semi-insulating character of these two samples*"- (emphasis added)).

In the sentence bridging pages 4382 and 4383 of the article, and in the following sentence on page 4383 of the article, Heitz states that in addition to the luminescence observed attributable to the tri-positive cation of iron, luminescence was attributed to Cr^{4+} and Ti^{2+} as well.

In the results section of the article, on page 4383, Heitz notes that iron "is a general contamination of the crystals" used in their work, and that the luminescence attributed to Fe^{3+} "is representative of all the samples investigated" (including crystal characterized as n-type).

Heitz ignores the basic standard that semi-insulators are characterized by bulk resistivity, and not a luminescent signature. Heitz contains no resistance measurements, no potential gradient determinations, and no rigorous basis for characterizing any GaN material as being semi-insulative in character. Further, the luminescence that is the sole basis of the semi-insulative characterization, is attributed to general contamination of the crystals by iron, chromium and titanium, contaminants that are conceded by the authors to be present in all crystal material considered by them, including n-type crystal material.

One skilled in the art knows that n-type crystal material is NOT semi-insulative material, and that n-type material and semi-insulative material reside in different bulk resistivity regimes that demarcate them as n-type or semi-insulative. Heitz therefore is seen to be confusing and contrary to common sense.

Thus, since neither Cho nor Heitz teach or fairly suggest "semi-insulating gallium nitride," the references fail to teach all of the limitations of claims 2-12, 17-21, 31-34, and 37-38, as required by MPEP 2143.03 to support a *prima facie* case of obviousness. For at least this reason, withdrawal of the rejection of these claims under 35 U.S.C. § 103(a) is warranted, and respectfully requested.

Likewise, for at least the reason that claims 2-12, 17-21, 31-34, and 37-38 all depend, whether directly or indirectly, from claim 1 and require the presence of "semi-insulating gallium nitride," withdrawal of the rejections of these claims is warranted.

Indeed, the examiner admits that any combination of Cho and Heitz fails to teach the subject matter of multiple claims, including claims 12, 13, 17-21, 31-34, 37, and 38. See January 10, 2006 Office Action, paragraphs 29-41. To support the obviousness rejection of these claims, the examiner relies upon case law cited at paragraph 44 of that Office Action; however, that case law is clearly premised on the prior establishment of a *prima facie* case of obviousness as to independent claim 1. It has been previously demonstrated herein that neither Cho nor Heitz teach any "semi-insulating gallium nitride" as required by claim 1, which is a prerequisite for establishing a *prima facie* case of obviousness under MPEP 2143.03. Thus, the case law relied upon by the examiner in paragraph 44 is inapposite here, such that there is no tenable basis for the rejection of claims 12, 13, 17-21, 31-34, 37, and 38 given the acknowledged lack of disclosure of the subject matter of these claims, and the rejections of these claims under 35 U.S.C. § 103(a) should be withdrawn.

Additional bases for distinction exist between the dependent claims and the disclosures of Cho and Heitz. For example, claims 5-8 recite manganese, cobalt, nickel and copper, respectively. There is no mention of such species in Cho or Heitz as dopants for GaN.[1] Accordingly, such claims patentably distinguish over Cho and Heitz and are in condition for allowance.

Based on all of the foregoing, Applicants respectfully request the examiner to reconsider, and upon reconsideration to withdraw, the rejections of claims 1-41.

[1] It is noted that Heitz, et al. discloses manganese, but in zinc sulfide, not GaN; nickel is discussed in connection with zinc sulfide and cadmium sulfide, but not in connection with GaN; copper is mentioned in connection with II-VI semiconductors, but not in connection with III-V semiconductors such as GaN.

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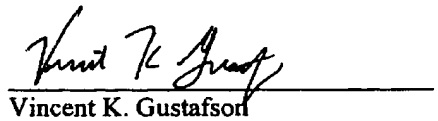
If any issues remain outstanding, the Examiner is requested to contact the undersigned attorney at (919) 419-9350 to resolve the same.

Respectfully submitted,



Vincent K. Gustafson
Reg. No. 46,182
Attorney for Applicants

INTELLECTUAL PROPERTY/
TECHNOLOGY LAW
Phone: (919) 419-9350
Fax: (919) 419-9354
Attorney File No.: 4241-661

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